

Surgical versus Non-Surgical Intervention for Vocal Cord Polyp (Systematic review)

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Abstract: Introduction: Voice is an audible sound produced by phonation that acts as a carrier wave for speech signal. Any disruption of the function of voice is called dysphonia. Etiology of dysphonia can be divided into three groups: 1-Organic voice disorders with detectable morphological changes in the vocal apparatus. 2- Non-organic (functional) voice disorders without detectable organic pathology in the structure of the larynx. 3- Minimal associated pathological lesions (MAPLs); long standing functional voice disorders leading to the creation of detectable organic changes. **Objective:** The aim of this work is the evaluation of functional outcome of voice therapy versus phonosurgery in the management of vocal cord polyp. **Subjects and methods (systematic review)** Criteria for inclusion and exclusion of studies in the review Studies included in the review must contain the following elements: Inclusion Criteria: Intervention: Articles that focus on surgical versus non-surgical intervention for vocal cord polyp Time and place: No time or place constraints. **Results:** There were differences between surgical and non-surgical intervention in vocal cord lesions determined according to the lesion. **Conclusion:** voice therapy as a first line treatment proved to be effective in improving dysphonia in patients with polyp, although complete cure after voice therapy is still far to be obtained in most cases.

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Key words: vocal cord polyp, voice therapy, surgical methods.

1. Introduction

Voice is an audible sound produced by phonation that acts as a carrier wave for speech signal (*Aronson, 1990*). Any disruption of the function of voice is called dysphonia (*Kotby, 1986*). Etiology of dysphonia can be divided into three groups: Organic voice disorders with detectable morphological changes in the vocal apparatus; non-organic (functional) voice disorders without detectable organic pathology in the structure of the larynx and minimal associated pathological lesions (MAPLs); long standing functional voice disorders leading to the creation of detectable organic changes (*Kotby, 1995*).

Vocal fold polyps, nodules, cysts, Reinke's edema and polypoid degeneration, and contact granulomas are examples of these lesions (*Mosallam et al., 1986*). These benign lesions are grouped together because they share certain common features (*Kleinsasser, 1991*). They have common predisposing factors: vocal trauma, smoking and other laryngeal irritants. They have related histopathological features: they are non-neoplastic and non-inflammatory. They have common presenting symptoms: dysphonia with or without phonasthenia. According to the protocol of voice evaluation developed at the Phoniatics Unit, Ain Shams University, voice evaluation includes: Elementary diagnostic procedures, clinical diagnostic procedures and additional instrumental measures. Management of any voice disorder may follow one or

a combination of the following lines (*Bouchayer and Cornut, 1992*): Pharmacotherapy, phonosurgery and behavioral readjustment voice therapy.

Aim of the Work

The aim of this work is the evaluation of functional outcome of voice therapy versus phonosurgery in the management of vocal cord polyp, in order to evaluate the applicability of these procedures to patients with these lesions. This will be made by conducting a systematic review of literature in this topic area.

2. Methods

This literature review sought to answer the following guiding question: Is speech therapy effective in the treatment of vocal fold polyp or surgical intervention is more effective?

The bibliographic research was conducted through:

- Public Medline
- PubMed platform
- Besides the Scopus
- Science Direct
- Cumulative Index to Nursing and Allied Health Literature
- CINAHL and Web of Science databases within the period from 2004 to 2017.

The Cochrane database was also consulted to confirm the inexistence of systematic review article on the topic.



Medical Subject Headings (MeSH) descriptors and free terms in English language (all fields) relevant to the research were used. The free term vocal polyp was used in quotation marks and individually crossed with the following descriptors, with the Boolean marker (Any kind of logic, function, expression, or theory based on the work) and:

- Speech therapy, therapeutics,
- Treatment outcomes and voice training; treatment,
- Vocal therapy,
- Vocal technique,
- And surgical intervention.

As inclusion criteria, all the original articles that used speech therapy as treatment in addition to articles

involving surgical intervention for vocal polyp found in the search were considered, without restrictions in relation to the characteristics of the participants and/or lesion, publication date or language.

Vocal cord polyp

Articles that exclusively addressed treatment of other MAPLS were excluded from the search. Chapters of books, dissertations, theses, literature reviews, case studies, reviews and editorials were not considered.

After identification in the databases, the articles were initially selected by title and reading of the abstract according to the inclusion and exclusion criteria.

After reading the abstract, in the case of doubts, the complete text of the article was read and its inclusion agreed between the reviewers. The repeated articles were disregarded. Also, all articles referenced by the elected articles that met the inclusion criteria after initial selection by title and later by summary were considered.

The final articles were evaluated in relation to methodological quality, use of statistical analysis.

After this process, the articles were completely analyzed observing the previously elaborated protocol containing the following variables:

Author, location, effectiveness of the therapy, number of patients, type of polyp, type of intervention.

3. Results

Table (1): Results of the studies according to variables analyzed

Author \ year	Number of Patients	Location	Mean of age	Laterality	Type of polyp	Type of intervention	Effectiveness
<i>Supoporn.sriromp et al. (2004)</i>	42 patients	Thailand	42	Unilateral vocal cord polyp	-angiomatous -gelatinous	Conservative treatment (voice therapy)	Complete resolution of all patients
<i>Seth M.cohen (2007)</i>	57 patients (32 missed during treatment)	Canada	43	Bilateral vocal cord polyp	translucent type	Voice therapy	Complete resolution 42%
<i>Hideki (2012)</i>	512 patients (79 missed during treatment)	Japan	47.8	Bilateral vocal cord polyp	Translucent type	Conservative treatment (voice therapy)	Complete resolution 40%
<i>Schindler et. al. (2012)</i>	16 patients (1 missed during treatment)	Italy	49.7	Unilateral	Hemorrhagic type	Voice therapy	Complete resolution 97%
<i>Jane et al. (2013)</i>	63 patients (9 missed during treatment)	Denmark	41	Unilateral	Vocal cord polyp especially in anterior commissure	Surgical intervention	-85% improved, voice quality unaffected -13% improved but moderately affected -severely affected in 1 patient
<i>Woo Jin et al. (2014)</i>	94 patients (12 missed during treatment)	Korea	65	Unilateral	-hemorrhagic 47% -organized 28% -translucent 25%	Conservative treatment (voice therapy)	Complete resolution in 36 patients of the study
<i>Pan Zhuge et al. (2015)</i>	66 patients (46 missed during treatment)	China	46	Unilateral	Translucent polyp	Voice therapy	Curative rate 30.3%

	treatment)						
<i>Maria Rosaria et al. (2016)</i>	140 patients (10 missed during treatment)	Italy	43.1	Bilateral	Hemorrhagic polyp	-voice therapy -surgical intervention	Complete resolution in 50% of each group
<i>Tatjana Solmen et al. (2016)</i>	61 patients (1 missed during treatment)	Germany	45	Unilateral	Translucent type	Surgical intervention	Complete resolution 90%
<i>Matthew R. Nau et al. (2017)</i>	66 patients (44 missed during treatment)	U.S.A	42	Unilateral	Gelatinous polyp	Voice therapy	Complete resolution 30%
<i>Lee et al. (2017)</i>	92 patients (52 missed during treatment)	Korea	51	Bilateral	vocal cord polyp especially sessile type	Voice therapy	Complete resolution 60%
<i>Yen Bin et al. (2009)</i>	24 patients	Chicago	49	Bilateral	Translucent hemorrhagic fibrotic	Percutaneous corticosteroid injection	Complete remission 59%
<i>Lilin et al.</i>	60 patients	China	44.5	Unilateral	Translucent	Combined therapy	Complete resolution 70%

Table (2): Acoustic values before & after voice therapy

Author	Test	Before voice therapy	After voice therapy	P-value
Schindler et al. 2012	Jitter %	2.3±1.27	1.9±0.97	0.04
	Shimmer %	4.8±1.95	4.2±1.29	0.06
	HNR	0.13±0.14	0.10±0.02	0.04
	Fo	186±54.03	173±42.7	0.64
Yoon Se Lee et al. 2013	Jitter %	1.87±1.92	1.79±1.46	0.82
	Shimmer %	4.64±4.12	4.10±2.73	0.45
	HNR	0.30±0.96	3.02±20.78	0.20
Pan Zhug et al. 2015	Jitter %	1.50±0.68	1.27±0.50	-0.134
	DSI	- 0.26±1.46	0.89±1.42	-0.014
	Fo	390.17±50.95	408.98±46.24	0.000
	I-low	58.30±4.45	56.06±4.17	0.198
Abd Elhady et al. 2017	Jitter %	5.5±2.97	5±2.1	0.58
	Shimmer %	1.6±0.5	1.47±0.4	0.45
	HNR	2.5±4.4	3.97±4.2	0.27

According to *Shindler et al. (2012)* Videostroboscopic examination did not reveal resolution of the initial pathology in any case. Patients had the maximum phonation time MPT of 14.4 ± 7.5

seconds before voice therapy and 14.9 ± 7.9 seconds after. The difference with a Wilcoxon signedrank test was not significant (p = 0.33).

Table (3): Acoustic values before & after the surgery

Author	Test	Pre-Operative	Post operative	P-value
Toran et al. 2010	Jitter %	0.2	0.19	0.694
	Shimmer %	2.18	1.73	0.001
	HNR	23.97	22.48	0
	Fo	212.32	196.51	0.003
Lilin et al. 2014	Jitter %	4.50±0.93	4.21±0.91	>0.05
	Shimmer %	6.84±1.24	6.43±2.25	>0.05
	HNR	0.51±0.05	0.47±0.12	>0.05
	PPQ %	3.36±1.05	3.09±0.82	>0.05
Sharon S. Tang et al. 2015	Jitter %	1.56±4.91	0.35±0.95	0.41
	NHR	0.002±0.03	-0.003±0.06	0.93
	VHI	31±21.6	14.88±16.47	0.04
	DSI	3.25±6.71	-0.14±5.16	0.95

Table (4): Curative rate among the analyzed studies

The authors	Non surgical		Surgical	
	No. (%)	Total No.	%	Total No.
1- Jane B. et al. (2013)	--	--	54 (85.7%)	63
2. Woo Jin et al. (2014)	36 (38.3%)	94	154 (100.0%)	154
3. Hideki N. (2012)	55 (41.7%)	132	433 (100.0%)	433
4. Seth M.cohen (2005)	25 (43.9%)	57	--	--
5. A. Schindler et al., 2012	15 (93.8%)	16	--	--
6. Maria Rosaria et al. (2016)	70 (100.0%)	70	70 (100.0%)	70
7. Pan Zhuge et al. (2015)	20 (30.3%)	66	--	--
8. Supopornsriron et al. (2004)	42 (100.0%)	42	--	--
9. Tajena Solmen et al. (2016)	--	--	60 (98.4%)	61
10. Matthew R. Nau et al. (2017)	22 (33.3%)	66	--	--
11. Lee et al. (2017)	40 (43.5%)	92	--	--
Total [no. (%)]				
Complete resolution	325 (51.2%)	635	771 (98.7%)	781
No complete resolution	310 (49.8%)		10 (1.3%)	
Chi-square test / p-value	X² = 452.5 / p-value = < 0.001			

Table (5): The table shows curative rate among the analyzed studies according to age with p-value < 0.001

	Non-surgical (Voice therapy)		Surgical	
	No. of cases	Mean age (years)	No. of cases	Mean age (years)
Jane Berg et al. (2013)			55	41
Woo Jin et al. (2014)		65	157	50
Hideki Nakagawa (2012)	94	47.8		
Seth M. Cohen (2005)	512	36		
Supaporns et al. (2004)	57	42		
A.Schindler et al. (2012)	42	49.7		
Mario Rosaria et al. (2016)	16	43.1		42.4
Lee et al. (2017)	70	51	70	
Tajana Salmen (2016)	92		61	45
Sharon S. Tong (2015)			62	40.25
Total no. / Average age (years)	883	47.80±9.17	405	43.73±3.95
Independent t-test / p-value	t = 8.573 / p < 0.001			

Table (6): Duration of follow up

The author	Non surgical		Surgical	
	No.	Period	No.	Period
1- Jane Bjerg Jensen et al. (2013)			55	3-9 months
2- Woo. Jin et al. (2014)	157	2-3 months		
3- R. Speyer (2008)	97	2 months		
4- Hideki Nokagawa (2012)	94	4.1 months		
5- Seth. M. Coren (2007)	512	3 months		
6- Micheel M. Jdn (2003)			50	3-4 months
7- Yu Zhang et al. (2004)			30	17 days
8- Lucian et al. (2003)	30	2 months		
9- Supaparn et al. (2004)	57	1-6 months		
10- A. Schindler et al. (2012)	42	1-2 months		
11- Maria Rosria et al.	16	3 months	20	5 weeks
12- Yoon Se Lee (2013)	70	2 months		
Total number	1075		155	
Total mean±SD	2.57 ± 0.79		3.75 ± 2.4	
Independent t-test	t = 12.196 p < 0.001			

4. Discussion

Non-neoplastic vocal fold lesions impair communication and have important public health implications. (Roy *et al.*, 2005) reported that 29.9% of the general public had at least one voice disorder in their lifetime, 6% had a current voice disorder, and 7.2% missed one or more work days. In addition to health care costs related to treatment and lost work productivity, benign vocal fold lesions such as polyps and cysts impair patients' quality of life. Cohen *et al.* (2006) suggested that determination of appropriate treatment may bring benefits not only to the individual but also to society.

Vocal fold polyp is a common disorder of the larynx, typically observed as unilateral masses of the free edge of the vocal fold. Most phonosurgeons consider surgery to be the mainstay of treatment of these lesions (Benjamin, 1998).

Most authors agree that the optimal treatment of benign lesions of the larynx is complex and includes several factors such as good patient compliance, the surgical method applied and pre/ or post-operative voice therapy (Jensen and Rasmussen, 2013).

There are several treatment options for vocal fold polyp which typically include either voice therapy from an SLP, or a combination of voice therapy and laryngeal microsurgery by an otolaryngologist. Most authors recommend voice therapy as the primary treatment, with surgery as a secondary alternative (Hogikyan *et al.* 1999). Benninger *et al.* (1996) stated that removal surgery may be necessary when behavioral interventions are not effective. Nevertheless, it is not impossible that the vocal range will be permanently altered post surgery.

But other studies on the treatment of vocal cord polyps mainly focused on surgery, particularly on the superiority of phonomicro surgery (Petrovia *et al.*, 2011 and Uloza *et al.*, 2005).

The success rate of voice treatment depends on many factors including: chronicity, nature of etiology, medical history, presence or absence of secondary gains, variability of treatment techniques, treatment duration, clinician's skill and knowledge, clinician's personality, client motivation and confidence in treatment, client adherence, client's perception of voice therapy, the need to take time off work to attend therapy and to practice target voice behaviors, and the time required to travel to therapy (Patel *et al.*, 2011).

However, despite the predominant use of the associated form of direct and indirect speech therapy, the studies presented different treatment frequency and duration. It is also emphasized that the continuous orientation regarding vocal health during the therapeutic process probably plays a more educational role when compared to a single orientation moment,

according to the approach of the analyzed study (Yun *et al.*, 2007).

There is a general consensus that surgical treatment of the polyp should aim at removing them in of mucosa from the vocal cord. Whether cold surgical techniques are better than laser treatment has not been determined with certainty but with newer instruments the surgical result is more likely to be dependent on the skill and experience of the surgeon rather than the tool (Pedersen and McGlashan, 2012).

Zeitels *et al.* (2002) also reported a low rate (4.2%) of second recurrence of vocal fold polyps when patients received a combination of surgery and voice therapy.

Several studies raised the possibility that immediate surgery may not be appropriate for all patients. Cohen and Colleagues (2007) presented one of the first studies reporting the utility of voice therapy as the first line treatment for VF polyps.

Voice treatment is often more cost effective than surgery, because it requires less time away from work, and is less traumatic (Pannbacker, 1999). In addition, although surgery is an effective treatment for vocal fold polyp, the patients have to be treated in combination with postoperative voice therapy to reduce the risk of recurrence (Bequignon *et al.*, 2013).

The possibility of speech therapy indication in the treatment of vocal fold polyp is relatively recent. The first articles about the topic appeared a little over a decade ago, from two different studies. The first suggested speech therapy as initial treatment for nodules and polyps Johns (2003) and the second identifies the discrepancy of its primary indication by otorhinolaryngologists (91% for nodules and 30% for polyps) Sulica *et al.* (2003). Furthermore, there is the observation of spontaneous resolution of some polyps, during the preparation period for surgery Cecatto *et al.* (2002). As a result, the studies analyzed in this review had the direct or indirect objective of verifying the effectiveness of speech therapy in the treatment of benign vocal fold lesions, specifically the vocal polyp.

The lack of standardization also corresponded to the use of speech techniques in direct speech therapy. Few articles describe the techniques that were used in the treatment (Schindler *et al.*, 2012; Rodríguez-Parra *et al.*, 2011 and Cho *et al.*, 2011).

The retrospective design of some of the analyzed articles (Nakagawa *et al.*, 2012; Cho *et al.*, 2011; Yun *et al.*, 2007 and Cohen *et al.*, 2007) with search for information in medical records, showed methodological biases, such as incomplete filling out of the protocols, lack of standardization of the information, different technical approaches and different assistant professionals. On the other hand, it was these studies that enabled the higher number of

participants in the sample, enabling the execution of a more consistent statistical analysis and determination of the characteristics of the polyps that best respond to speech therapy, especially in relation to the size and/or age (time of existence) of the lesion.

The studies on intervention that had a methodological structure could roughly be divided into four groups according to the line of treatment:

1. Voice therapy (*Pan Zhuge et al., 2015; Supoporn. sriromp et al., 2004; Lee et al., 2017; Schindler et al., 2012; Cohen et al., 2005 and Nakagawa, 2012*).

2. Surgical intervention (*Tatjana Solmen et al., 2016; Sharon S. Tong et al., 2015 and Jane Berg et al., 2013*).

3. Voice therapy and Surgical intervention (combined therapy) (*Maria Rosaria et al., 2016 and Woo Jin et al., 2014*).

4. Corticosteroid injection for V.C polyp (*Yen Bin et al. 2009*).

As regarding to age group the mean age in the studies of voice therapy was 47.80 ± 9.17 , and the mean age in the studies of surgical intervention was 43.73 ± 3.95 with high statistical significance in between with p -value < 0.001 .

Most of the studies raised the possibility of complete cure after surgical intervention to approach 98.7%, while complete cure in the other studies which stated Voice therapy and injection of corticosteroid was 51.2% with high statistical significance in between.

Acoustic values before and after voice therapy were Jitter, Shimmer %, HNR, and Fo with no statistical significance before and after voice therapy with P value (0.04, 0.06, 0.04, 0.64 respectively).

Acoustic values before and after the surgery were Shimmer %, HNR, and Fo with high statistical significance before and after surgery with P value (0.001, 0.000, 0.003 respectively). while Jitter % pre and post-operative was of no significance with P value 0.694.

Jitter refers to cycle to cycle variation in the fundamental frequency of the voice.

Shimmer is also a measurement of perturbation. It refers to cycle to cycle variation in the amplitude of voice.

The decreased HNR value is a powerful quantitative indicator for the improvement of voice quality (Toran and Lal, 2010).

There is two studies describing microsurgery and voice therapy included 164 patients with complete cure in 128. The six studies concerned with voice therapy alone included 339 patients 164 of which had a complete cure. The three studies describing surgical intervention alone included 557 patients 547 of which had a complete cure.

Nakagawa et al. (2012) commented that in comparing patients in their study who showed complete remission with those who did not show either remission or shrinkage, the former group had a greater proportion of women, small lesions, and a shorter duration of symptoms.

That agrees with the study done by *Zeitels et al. (2002)*, who prospectively investigated treatment outcomes in 185 singers who had undergone phonosurgery and vocal rehabilitation. A total of 182 patients (98%) reported voice improvement after surgery.

Although polyp being one of the most frequent benign lesions in vocal folds, the eleven studies on intervention showed a variable number of participants, which varied from 16 to 433.

Lee et al. (2017) stated that patients with small polyps and female patients showed the most effective response to voice therapy. Among the cases of small polyps, the sessile type rather than the pedunculated type was found to be a good indicator for effective voice therapy.

There have been some reports regarding the efficiency of conservative treatments for vocal fold polyps based on voice therapy. Although it has longer treatment duration than surgical therapy, voice therapy has been reported to improve voice outcomes by 20%–49% (*Cohen et al., 2007 and Yun et al., 2007*).

There some studies assessed patients with Hemorrhagic polyp *Woo Jin et al. (2014)* which was present in 47% of the examined patients it was considered the most frequent type of vocal polyp they were treated with both Voice therapy and Surgical intervention with complete cure after Surgical intervention and 38% cure after Voice therapy.

Most authors agree that the optimal treatment of benign lesions of the larynx is complex and includes several factors such as good patient compliance, the surgical method applied and post-operative voice therapy (*Geyer et al., 2010 and Zeitels et al., 2002*). Post-operative voice therapies were done in two studies from the eleven studies (*Maria Rosaria et al., 2016 and Woo Jin et al., 2014*) with complete cure in 100%, 38% respectively.

As regard to follow up *Jane Berg et al. (2013) and Cohen et al. (2007)* stated that as the vast majority of patients had normal voices after three months, their visits could be terminated, which yielded a median follow-up period of 3.9 months, which is considerably shorter than in other studies.

Although polyp being usually unilateral the case series studies or clinical trials showed a limited number of participants with bilateral polyps (*Maria Rosaria et al., 2016; Lee et al. 2017; Hideki, 2012 and Cohen, 2007*).

According to the study done by **Yen Bin et al. (2009)** Percutaneous corticosteroid injection under topical anesthesia was performed successfully in 22 of the 24 patients (92%). The procedure was typically completed within 20 minutes, including the time for topical anesthesia and injection. Two patients failed to complete the procedure because of the thick, soft tissue in the anterior neck or hypersensitive gag reflex. The median follow-up time from the PCI was 15 months (range, 9-19 months).

Another important aspect is the classification difference in terms of size of the lesions in the studies. Although estimating basically three sizes (small, medium and large), the authors classified them differently. Therefore, the small polyp, for example, was considered punctiform **Klein et al. (2009)** and **Nakagawa et al. (2012)** with size corresponding up to 1/8 of the vocal fold **Yun et al. (2007)** or with a size up to 1/4 of the vocal fold **Cho et al. (2011)**. Despite the classification used, four studies identified the best response to speech therapy in small polyps (**Yun et al., 2007; Nakagawa et al., 2012 and Cho et al., 2011**). At the same time, five studies did not assess the size of the polyp (**Cohen et al., 2007; Rodríguez-Parra et al., 2011; Adrián et al., 2015; Schindler et al., 2013 and Schindler et al., 2012**).

Conclusion

Voice therapy as a first line treatment proved to be effective in improving dysphonia in patients with polyp, although complete cure after voice therapy is still far to be obtained in most cases.

While complete cure can be obtained in most cases after surgical treatment. Patients who received corticosteroid therapy reach to 59% curative rate.

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